REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 18, 19, 21, 24, 25, 27-30, 32, 35, 36, and 38-40, 42 and 43 will be pending in the application subsequent to entry of this Amendment.

Independent claims 18, 29, 42 and 43 have been amended in order to more particularly point out and distinctly claim that which applicants regard as their invention, to direct them to preferred aspects of the disclosure and to further distinguish from the applied prior art.

In claim 18 the "solvent" for preparing the fatty emulsion is water as stated in previous claim 20 and, in step (b), mixing the fatty emulsion with the coloring powders to obtain a paste is at a ratio of about 50/50% by weight of fatty emulsion to coloring powders which is featured in claim 23 and now incorporated into claim 18.

The drying step (d) follows directly extruding the paste to obtain an extruded product. This is based on the description of the invention found at page 8, lines 8-22. This Amendment emphasizes that the extruded product is directly dried and not subjected to further compression such as a "standard cosmetic powder compression molding device" mentioned at column 4, lines 29-30 of the Verdon et al reference.

A period appearing inadvertently after "triglycerides" and before "waxes" has been replaced with a comma to correct a typographical error.

The product produced by the process is a dry non-pressed powder of solid consistency.

Similar changes have been made to independent claims 29, 42 and 43 and claims 20, 23, 31 and 34 have been canceled as redundant in view of the amendments made to the two independent claims.

Basis for the amendments to the claims will be apparent from the description and the above comments; no new subject matter has been introduced into the claims.

All pending claims are again rejected as being "obvious" over U.S. patent 4,994,264 to Verdon as explained in detail on pages 2-4 of the Official Action.

Also cited and applied in the Official Action is U.S. patent 4,332,763 to Hempel et al but was applied only to claims 18, 29, 42 and 43 with the incorporation of claims 20 and 23 into claim 18 and claims 31 and 34 into claim 29 this rejection is moot as the claimed subject matter

introduced from dependent claims 20, 23, 31 and 34 is not included in the rejection based on Hempel.

Accordingly, applicants will focus attention on the deficiencies of the Verdon et al reference and the manner in which the current claims distinguish from the disclosures of that document.

As explained above, the solvent used for cosmetic use is water which is in distinction from the disclosure of Verdon which discloses that the slurry he prepares always includes a polar solvent. An important distinction resides in mixture of powders: according to the present invention, this mixture is actually made by solid powders, i.e. pigments and other powders as diluents, whereas the alleged "powder components" disclosed by Verdon in the Example, column 4, lines 60 onwards also include liquid, fatty compounds, such as, at least, iso-octyl palmitate, polyglyceryl-3-diisostearate and 20-phenoxyethanol. These three materials, given as examples, are all fatty liquids as shown in the material data sheets or monographs for polyglyceryl-3-diisostearate "a clear-yellowish liquid ...". The iso-octyl palmitate is defined as a "colorless oily liquid" and the 2-phenoxyethanol is also described as an "oily liquid".

So, the cosmetics of the amended clams do not include a polar solvent and are prepared by a different process, according to which fats are only present in the liquid phase.

As for the technical process of preparing the products, the cosmetics of the present invention are only extruded, optionally sized, and dried. This can be made because they have a solid consistency when they exit from the extruder.

On the contrary, Verdon's cosmetics need to be molded in a compression molding machine. This latter is an apparatus which press materials, in this case a paste, in a mold, so that the material takes the form of the mold. The resulting cosmetics are "pressed-powders" as those acknowledged by applicants in the application at page 1, lines 15-18 and as in the examples of press-powders shown to the examiners last year.

So, the extruder gives shape to a paste by forcing it through a die whereas the compression moulding device gives a shape to a paste by pressing it into a container.

Enclosed herewith are web pages relating to the compression molding and the extrusion processes, as well as schematic drawings that clearly show the difference between the two.

Consider also the working example in the Verdon reference which in column (4), lines 50-52 there is a distinct separation between extrusion and press molding, in that the paste is prepared then extruded and thereafter press-molded followed by drying – each a distinct step in the process. Applicants' claims are above amended to exclude a press-molding step after extrusion.

Surely there is a difference in texture of the two types of compounds as the cosmetics of the invention come out from the extruder in a solid form and do not need any further compression. The ratio 50/50 by weight of the fatty and the powder mixture is likely to be important in order to get this result. In the example given by Verdon, the slurry/powder ratio is 27.3 to 72.7; this high amount of powders could be the reason for the need of the compression molding, as the paste obtained should be more dry and dusty and therefore it would require to be pressed in a container.

For the above reasons it is respectfully submitted that the claims of this application define inventive subject matter. Reconsideration and allowance are solicited. Should the examiner require further information, please contact the undersigned.

Respectfully submitted,

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PRODUCT: LAMEFORM® TGI	PURCHASE PRODUCT
Manufacturer: Cognis - Care Chemicals Product Type: Water_Oil Industry: Personal Care Category: Emulsifiers	This Product Is Unavailable To Purchase Online

PRODUCT DESCRIPTION

"LAMEFORM® TGI, INCI: Polyglyceryl-3-Diisostearate, is a clear, yellowish liquid which turns cloudy at room temperature.This cloudiness is reversible by heating. The product is used as W/O emulsifier even for cold manufacture. The product is suited for the production of cosmetic emulsions as well as lipophilic sticks and ointments. **For Technical Data Chemidex"**

LITERATURE AVAILABLE ONLINE FOR THIS PRODUCT

Request Product Literature

Place an Order   Request Product Sample

Iso-Octyl Palmitate

+ Add to Basket

No Photo

Product Description

Chemical name:
ISO-octyl Palmitate
Molecular formula: CH3(CH2)14COOCH2CH(C2H5)(CH2) 3CH3
Molecular weight: 368
CAS#: 1341-38-4

Property: Colorless oily liquid, can be dissolved with organic solvents, insoluble in water.

Specification: Enterprise standard
Test Specification
Description(25): Light amber clear oil
Special gravity (25): 0.850~0.860
Refractive index (25): 1.443~1.447
Acid number, mgKOH/g: d0.5
Saponification value, mgKOH/g: 150-154

Application: The ISO-octyl palmitate usually was used as emollient, solubilizer, bond, brightener, antisticking agent, lubricant, suspension agent, and anti-jam agent for bath products, skin care products, deodorizers, chemical compounds, lamination processing, lubrication, metal processing, antirust agents, textiles, leathers and ointments.

Storage: Stored in cool and dry place. Kept in airproof condition.
Packaging: Packed in polyethylene plastic pail (with inner cover), 25kg per pail.

Origin:	China
Company:	Qingzhou Ailitong Chemicals Co., Ltd.

Other products from this company

- Imidazolidinyl Urea (GM-115)
- Diazolidinyl Urea
- ALT-KT 2%
- ALT-GM IS-45

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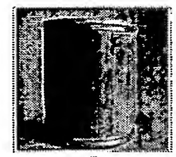
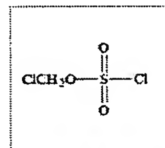
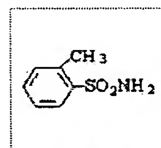


Dimethyl Oxalate (553-90-2)
Dimethyl oxalate Other names: Methyl oxalate; ...



Chloromethyl Chlorosulfate
1. Name: Chloromethyl chlorosulfate 2. ...



O-Toluene Sulfonamide
CAS NO. 88-19-7
Appearance: White crystalline ...

Recommended Products

Tetramethoxysilane (CAS NO. 681-84-5)

Quick Products

Vardenafil
Rosin
Ester
Polyester Powder Coating
Polyester Resin

- Quick Products, Search & Index, Still cannot find? Post Offer to Buy.
For China Manufacturers and Suppliers: Add your Products, Search Buyers, Promotion - Spotlight Exhibits, Recommended Products.
For Global Manufacturers and Suppliers: Post Offer to Sell, Recommended Offers.

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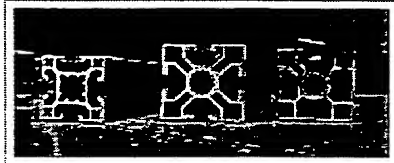
Monograph number: 7410
Title: 2-Phenoxyethanol.
CAS Registry number: [122-99-6]
Additional name(s): 1-Hydroxy-2-phenoxyethane; ethylene glycol monophenyl ether;β-hydroxyethyl phenyl ether;
Trade names(s): Phenoxethol; Phenoxetol (Nipa); Phenyl Cellosolve (Union Carbide).
Molecular formula: $C_8H_{10}O_2$
Molecular weight: 138.17
Composition: C 69.55%, H 7.30%, O 23.16%.
Line formula: $C_6H_5OCH_2CH_2OH$.
Literature references: Obtained by treating phenol with ethylene oxide in an alkaline medium: Becker, Barthell, *Monatsh.* **77,** 80 (1947); *see also* Roithner, *ibid.* **15,** 674, 678 (1894); Rindfusz, *J. Am. Chem. Soc.* **41,** 669 (1919). Toxicity study: H. F. Smyth *et al., J. Ind. Hyg. Toxicol.* **23,** 259 (1941).
Properties: Oily liquid. Faint aromatic odor. Burning taste. d_{20}^{20} 1.1094; d_4^{22} 1.102; mp 14°; bp_{760} 245.2°; bp_{80} 165°; bp_{25} 137°; bp_{20} 128-130°. n_D^{20} 1.534. Flash pt 250°F. Soly in water: 2.67 g/100 ml. Freely sol in alcohol, ether, NaOH solns. LD_{50} orally in rats: 1.26 g/kg (Smyth).
Melting point: 14
Boiling point: 245.2; 165; 137; 128-130
Density: 1.1094; 1.102
Refraction: 1.534

Derivative: Acetate
Molecular formula: $C_{10}H_{12}O_3$
Properties: liquid, bp 243°.
Boiling point: 243

USE: Fixative for perfumes, in org synthesis; as bactericide in conjunction with quaternary ammonium compds; as insect repellent.
THERAP CAT: Antiseptic (topical).

Extrusion

From Wikipedia, the free encyclopedia



Extruded aluminium; slots allow bars to be joined with special connectors.

Extrusion is a process used to create objects of a fixed cross-sectional profile. A material is pushed or drawn through a die of the desired cross-section. The two main advantages of this process over other manufacturing processes is its ability to create very complex cross-sections and work materials that are brittle, because the material only encounters compressive and shear stresses. It also forms finished parts with an excellent surface finish.[1]

Extrusion may be continuous (theoretically producing indefinitely long material) or semi-continuous (producing many pieces). The extrusion process can be done with the material hot or cold.

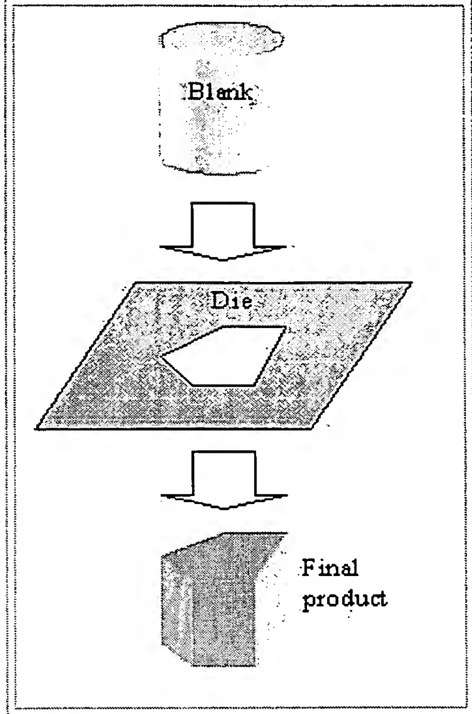
Commonly extruded materials include metals, polymers, ceramics, and foodstuffs.

Contents

History

In 1797, Joseph Bramah patented the first extrusion process for making lead pipe. It involved preheating the metal and then forcing it through a die via a hand driven plunger. The process wasn't developed until 1820 when Thomas Burr constructed the first hydraulic powered press. At this time the process was called squirting. In 1894, Alexander Dick expanded the extrusion process to copper and brass alloys.[2]

Process



Extrusion of a round blank through a die.

The process begins by heating the stock material. It is then loaded into the container in the press. A dummy block is placed behind it where the ram then presses on the material to push it out of the die. Afterwards the extrusion is stretched in order to straighten it. If better properties are required then it may be heat treated or cold worked.[2]

Hot extrusion

See also: Hot working

Hot extrusion is done at an elevated temperature to keep the material from work hardening and to make it easier to push the material through the die. Most hot extrusions are done on horizontal hydraulic presses that range from 250 to 12,000 tons. Pressures range from 30-700 MPa (5,000 to 100,000 psi), therefore lubrication is required, which can be oil or graphite for lower temperature extrusions, or glass powder for higher temperature extrusions. The biggest disadvantage of this process is its cost for machinery and its upkeep.[1]

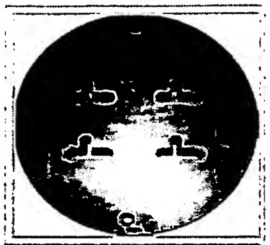
While hot extrusion may be costly in the machinery, the tooling cost is kept low. Since you can reuse the same "dies" for as many operations as needed. Tolerances are easily achievable. Many tolerances for extrusions are in the range of +-8% to +-10%. An advantage to extrusion molding is that in the end, there is very little finishing work required. Hot extrusions work best when the material needs to stay soft or maleable to make it through the die without breaking. Some examples would be glass, candy and certain types of rubber. [3]

Hot extrusion temperature for various metals[1]

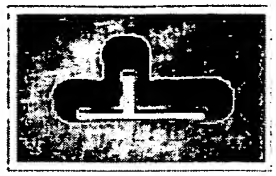
Material	Temperature [°C (°F)]
Magnesium	350-450 (650-850)
Aluminium	350-500 (650-900)
Copper	600-1100 (1200-2000)
Steel	1200-1300 (2200-2400)
Titanium	700-1200 (1300-2100)
Nickel	1000-1200 (1900-2200)
Refractory alloys	up to 2000 (4000)

The extrusion process is generally economical when producing between several kilograms (pounds) and many tons, depending on the material being extruded. There is a crossover point where rolling becomes more economical. For instance, some steels become more economical to roll if producing more than 20,000 kg (50,000 lb).[2]

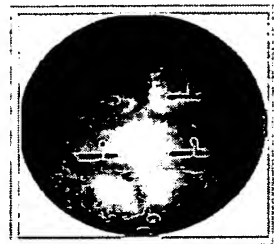
Aluminium hot extrusion die



Front side of a four family die. For reference, the die is 228 mm (9.0 in) in diameter.



Close up of the shape cut into the die. Notice that the walls are drafted and that the back wall thickness varies.



Back side of die. The wall thickness of the extrusion is 3 mm (0.12 in).

Cold extrusion

Cold extrusion is done at room temperature or near room temperature. The advantages of this over hot extrusion are the lack of oxidation, higher strength due to cold working, closer tolerances, good surface finish, and fast extrusion speeds if the material is subject to hot shortness.[1]

Materials that are commonly cold extruded include: lead, tin, aluminum, copper, zirconium, titanium, molybdenum, beryllium, vanadium, niobium, and steel.

Extrusion is a continuous high volume process thats allows you to accurately control material thickness. Some advantages to this type of process is a low tooling cost and materials can be cut to any desired length. Cold extrusion also allows the manufacturer to produce intricate profiles. [4]

This process of extrusion forces the material through a die. Dies can be made from many different types of material such as brass, copper, and also steel. The type of material often depends on the type of applications involved in the extrusion process and the amount of production it will experience. [5]

Examples of products produced by this process are: collapsible tubes, fire extinguisher cases, shock absorber cylinders, automotive pistons, and gear blanks.

Warm extrusion

Warm extrusion is done above room temperature, but below the recrystallization temperature of the material the temperatures ranges from 800 to 1800 °F (precisely from 426 to 982°C) . It is usually used to achieve the proper balance of required forces, ductility and final extrusion properties.[6] Warm Extrusion has a number of cost-effective advantages. Compared to cold extrusion warm extrusion has an higher advantage in reducing the pressure which must be applied to the material and increases steel ductility. Warm extrusion can also eliminate heat treatment which is may required for the cold extrusion for more information go to: http://www.monmet.com/en/extrusion.aspx

Equipment

There are many different variations of extrusion equipment. They vary by four major characteristics: [1]

1. Movement of the extrusion with relation to the ram. If the die is held stationary and the ram moves towards it then its called "direct extrusion". If the ram is held stationary and the die moves towards the ram its called "indirect extrusion".
2. The position of the press, either vertical or horizontal.
3. The type of drive, either hydraulic or mechanical.
4. The type of load applied, either conventional (variable) or hydrostatic.

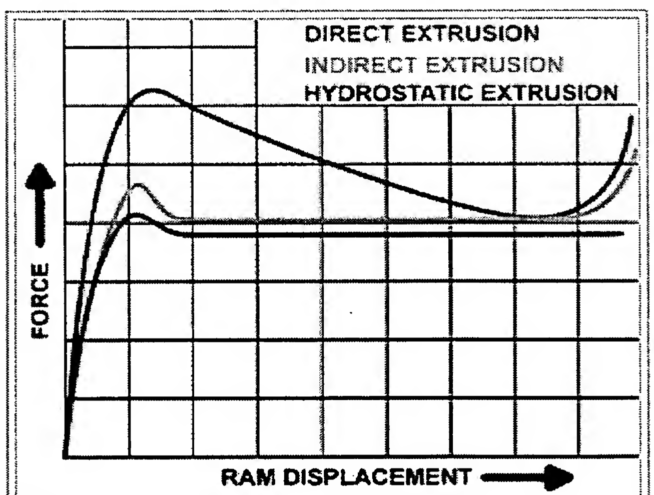
A single or twin screw auger, powered by an electric motor, or a ram, driven by hydraulic pressure (often used for steel and titanium alloys), oil pressure (for aluminum), or in other specialized processes such as rollers inside a perforated drum for the production of many simultaneous streams of material.

There are several methods for forming internal cavities in extrusions. One way is to use a hollow billet and then use a fixed or floating mandrel. A fixed mandrel, also known as a German type, means it is integrated into the dummy block and stem. A floating mandrel, also known as a French type, floats in slots in the dummy block and aligns itself in the die when extruding. If a solid billet is used as the feed material then it must first be pierced by the mandrel before extruding through the die. A special press is used in order to control the mandrel independently from the ram.[1] The solid billet could also be used with a spider die, porthole die or bridge die. All of these types of dies incorporate the mandrel in the die and have "legs" that hold the mandrel in place. During extrusion the metal divides and flows around the legs, leaving weld lines in the final product.[7]

Typical extrusion presses cost more than $100,000, whereas dies can cost up to $2000.

Direct extrusion

Direct extrusion, also known as forward extrusion, is the most common extrusion process. It works by placing the billet in a heavy walled container. The billet is pushed through the die by a ram or screw. There is a reusable dummy block between the ram and the billet to keep them separated. The major disadvantage of this process is that the force required to extrude the billet is greater than that need in the indirect extrusion process because of the frictional forces introduced by the need for the billet to travel the entire length of the container. Because of this the greatest force required is at the beginning of process and slowly decreases as the billet is used up. At the end of the billet the force greatly increases because the billet is thin and the material must flow radially to exit the die. The end of the billet, called the butt end, is not used for this reason.[8]



Plot of forces required by various extrusion processes.

Indirect extrusion

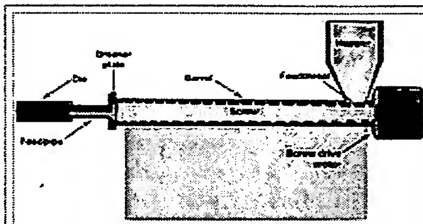
In indirect extrusion, also known as backwards extrusion, the billet and container move together while the die is stationary. The die is held in place by a "stem" which has to be longer than the container length. The maximum length of the extrusion is ultimately dictated by the column strength of the stem. Because the billet moves with the container the frictional forces are eliminated. This

(6 to 18 mm) thick is placed in the chamber on the die to lubricate the extrusion as it is forced through the die. A second advantage of this glass ring is its ability to insulate the heat of the billet from the die. The extrusion will have a 1 mil thick layer of glass, which can be easily removed once it cools.[6]

Another breakthrough in lubrication is the use of phosphate coatings. With this process, in conjunction with glass lubrication, steel can be cold extruded. The phosphate coat absorbs the liquid glass to offer even better lubricating properties.[6]

Plastic

Plastic extrusion commonly uses plastic chips or pellets, which are usually dried in a hopper before going to the feed screw. The polymer resin is heated to molten state by a combination of heating elements and shear heating from the extrusion screw. The screw forces the resin through a die, forming the resin into the desired shape. The extrudate is cooled and solidified as it is pulled through the die or water tank. In some cases (such as fibre-reinforced tubes) the extrudate is pulled through a very long die, in a process called pultrusion.

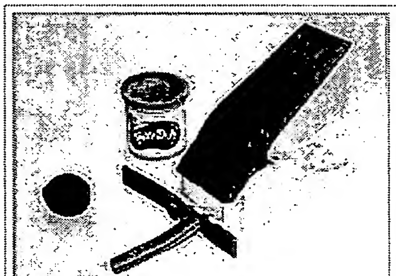


Sectional view of a plastic extruder showing the components

A multitude of polymers are used in the production of plastic tubing, pipes, rods, rails, seals, and sheets or films.

Ceramic

Ceramic can also be formed into shapes via extrusion. Terracotta extrusion is used to produce pipes. Many modern bricks are also manufactured using a brick extrusion process.[14] Some Play-Doh toy products also make use of the extrusion process.



Green Play-Doh with can and accessory extruder toy

Food

Extrusion has found great application in food processing. Products such as pastas, breakfast cereals, Fig Newtons, prefab cookie dough, Sevai, Idiappam, jalebi and ready-to-eat snacks are now manufactured by extrusion. Krispy Kreme doughnuts are also manufactured by extrusion to keep the doughnuts uniform in shape and size. Softer foods such as meringue have long been "piped" using pastry bags. Extrusion is also used with grains such as wheat, corn, and rice. In feed industry it is used for process with floating and slow sinking feed.

Drug carriers

Extrusion through nano-porous, polymeric filters is being used to manufacture suspensions of lipid vesicles liposomes or Transfersomes for use in pharmaceutical products. The anti-cancer drug Doxorubicin in liposome delivery system is formulated by extrusion, for example.

Design

The following guidelines should be followed to produce a quality extrusion. The maximum size for

an extrusion is determined by finding the smallest circle that will fit around the cross-section (called the circumscribing circle). This diameter, in turn, controls the size of the die required, which ultimately determines if the part will fit in a given press. For example, a larger press can handle 60 cm (25 inch) diameter circumscribing circles for aluminium and 55 cm (22 in). diameter circles for steel and titanium.[1]

Thicker sections generally need an increased section size. In order for the material to flow properly legs should not be more than ten times longer than their thickness. If the cross-section is asymmetrical, adjacent sections should be as close to the same size as possible. Sharp corners should be avoided; for aluminium and magnesium the minimum radius should be 0.4 mm (1/64 in) and for steel corners should be 0.75 mm (0.030 in) and fillets should be 3 mm (0.125 in). The following table lists the minimum cross-section and thickness for various materials.[1]

Material	Minimum cross-section [cm² (sq. in.)]	Minimum thickness [mm (in.)]
Carbon steels	2.5 (0.40)	3.00 (0.120)
Stainless steel	3.0-4.5 (0.45-0.70)	3.00-4.75 (0.120-0.187)
Titanium	3.0 (0.50)	3.80 (0.150)
Aluminium	<2.5 (0.40)	1.00 (0.040)
Magnesium	<2.5 (0.40)	1.00 (0.040)

See also

- Equal channel angular extrusion
- Hydrostatic extrusion
- Plastics extrusion
- Mini Twin Screw Extruder

References

Notes

1. ^ a b c d e f g h i Oberg, E.; et al. (1996). *Machinery's Handbook* (25th ed.). Industrial Press Inc.. pp. 1348–1349.
2. ^ a b c Drozda, pp. 13-11 & 13-12.
3. ^ Ref: Manufacturing Process Taxonomy
4. ^ [Manufacturing Process Taxonomy]
5. ^ Manufacturing Process Taxonomy
6. ^ a b c Avitzur, B. (1987), "Metal forming", *Encyclopedia of Physical Science & Technology*, **8**, San Diego: Academic Press, Inc., pp. 80–109.
7. ^ Drozda, p. 13-21.
8. ^ Drozda, p. 13-13.
9. ^ a b c d e Drozda, p. 13-14.
10. ^ a b Drozda, p. 13-16.
11. ^ Drozda, p. 13-20.
12. ^ Drozda, pp. 13-15 & 16.
13. ^ Bauser, Martin; Sauer, Günther; Siegert, Klaus (2006), *Extrusion*, ASM International, p. 270, ISBN 087170837X, http://books.google.com/books?id=9NnDQ0oJFLEC
14. ^ Brick manufacturing process

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- Drozda, Tom; Wick, Charles; Bakerjian, Ramon; Veilleux, Raymond F.; Petro, Louis, *Tool*

and manufacturing engineers handbook, **2**, SME, ISBN 0872631354, http://books.google.com/books?id=9ty5NPJ0UI4C.

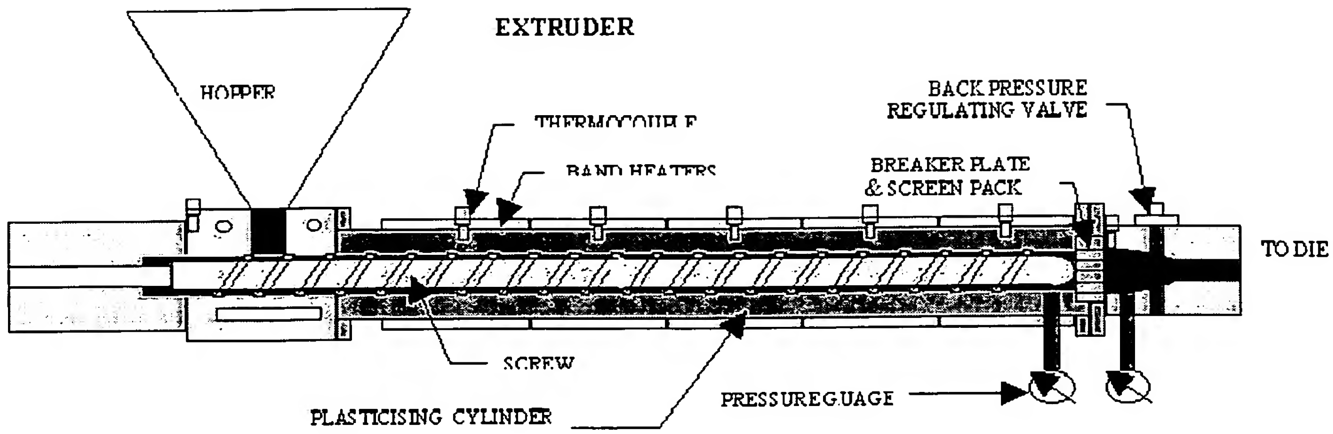
- Schmid, Serope Kalpakjian and Steven R. Manufacturing Engineering and Technology, Fifth Edition. Pearson Prentice Hall, 2006.

External links

- eFunda Engineering Fundamentals - Extrusion
- Extrusion cross-sectional tolerances

Retrieved from "http://en.wikipedia.org/wiki/Extrusion"
Categories: Food industry | Manufacturing | Metal forming | Unit operations
Hidden categories: Articles to be expanded since January 2008 | All articles to be expanded | Articles to be expanded since August 2008 | Articles containing how-to sections

- This page was last modified on 27 March 2009, at 14:55.


EXTRUDER
HOPPER
THERMOCOUPLE
BAND HEATERS
BACK PRESSURE
REGULATING VALVE
BREAKER PLATE
& SCREEN PACK
TO DIE
SCREW
PLASTICISING CYLINDER
PRESSUREGUAGE

Compression molding

From Wikipedia, the free encyclopedia


Compression molded rubber boots before the flashes are removed.

Compression molding is a method of molding in which the molding material, generally preheated, is first placed in an open, heated mold cavity. The mold is closed with a top force or plug member, pressure is applied to force the material into contact with all mold areas, while heat and pressure are maintained until the molding material has cured. The process employs thermosetting resins in a partially cured stage, either in the form of granules, putty-like masses, or preforms. Compression molding is a high-volume, high-pressure method suitable for molding complex, high-strength fiberglass reinforcements. Advanced composite thermoplastics can also be compression molded with unidirectional tapes, woven fabrics, randomly orientated fiber mat or chopped strand. The advantage of compression molding is its ability to mold large, fairly intricate parts. Also, it is one of the lowest cost molding methods compared with other methods such as transfer molding and injection molding; moreover it wastes relatively little material, giving it an advantage when working with expensive compounds. However, compression molding often provides poor product consistency and difficulty in controlling flashing, and it is not suitable for some types of parts. Compression molding produces fewer knit lines and less fiber-length degradation than injection molding. Compression-molding is also suitable for ultra-large basic shape production in sizes beyond the capacity of extrusion techniques. Materials that are typically manufactured through compression molding include: Polyester fiberglass resin systems (SMC/BMC), Torlon PAI, Vespel PI, Meldin PI, Ryton PPS, and many grades of PEEK.

Compression molding was first developed to manufacture composite parts for metal replacement applications, compression molding is typically used to make larger flat or moderately curved parts. This method of molding is greatly used in manufacturing automotive parts such as hoods, fenders, scoops, spoilers, as well as smaller more intricate parts. The material to be molded is positioned in the mold cavity and the heated platens are closed by a hydraulic ram. Bulk molding compound (BMC) or sheet molding compound (SMC), are conformed to the mold form by the applied pressure and heated until the curing reaction occurs. SMC feed material usually is cut to conform to the surface area of the mold. The mold is then cooled and the part removed. Materials may be loaded into the mold either in the form of pellets or sheet, or the mold may be loaded from a plasticating extruder. Materials are heated above their melting points, formed and cooled. The more evenly the feed material is distributed over the mold surface, the less flow orientation occurs during the compression stage.

Thermoplastic matricies are common place in mass production industries eg. automotive applications where the leading technologies are Long Fibre reinforced Thermoplastics (LFT) and Glass fibre Mat reinforced Thermoplastics (GMT).

In compression molding there are six important considerations that an engineer should bear in mind:

- Determining the proper amount of material.
- Determining the minimum amount of energy required to heat the material.
- Determining the minimum time required to heat the material.
- Determining the appropriate heating technique.

- Predicting the required force, to ensure that shot attains the proper shape.
- Designing the mold for rapid cooling after the material has been compressed into the mold.

Contents

Process definition

Compression molding is a forming process in which a plastic material is placed directly into a heated metal mold, then is softened by the heat, and forced to conform to the shape of the mold as the mold closes.

Process characteristics

The use of thermoset plastic compounds characterizes this molding process as many of the other molding processes. These thermosets can be in either preform or granule shapes. Unlike some of the other processes we find that the materials are usually preheated and measured before molding. This helps to reduce excess flash. Inserts, usually metallic, can also be molded with the plastic. As a side note, remember not to allow any undercuts on the shape, it will make ejection especially difficult. Thermoplastic matricies with an inherent indefinite shelf-life and shorter cycle moulding times are widely used and examples are shown in Ref 3.

Process schematic

The compression molding starts, with an allotted amount of plastic or gelatin placed over or inserted into a mold. Afterward the material is heated to a pliable state in and by the mold. Shortly there after the hydraulic press presses the pliable plastic against the mold, resulting in a perfectly molded piece. After the hydraulic press releases, an ejector pin in the bottom of the mold quickly ejects the finish piece out of the mold and then the process is finished. Also depending on the type of plunger used in the press there will or won't be excess material on the mold.

Workpiece geometry

This process is commonly used for manufacturing electrical parts, dinnerware, and gears. This process is also used to produce buttons, buckles, knobs, handles, appliance housing, radio cases, and large container. Common commercial examples are shown in Ref 3.

Setup and equipment

Compression mold presses are manufactured in a wide variety of sizes. Most presses utilize a hydraulic ram in order to produce sufficient force during the molding operation. The tools consist of

a male mold plunger and a female mold.

Typical tools and geometry produced

Three types of molds used are the flash plunger-type, straight plunger-type, and the "landed" plunger-type molds. The flash type mold must have an accurate charge of plastic and produces a horizontal flash (this is excess material that protrudes out of the mold). The straight plunger-type mold allows for some inaccuracy in the charge of plastic and produces a vertical flash. The landed plunger type mold must have an accurate charge of plastic, and no flash in produced. Further details are explained in Ref 3.

Bibliography

- Todd, Robert H., Dell K. Allen, and Leo Alting. Manufacturing Processes Reference Guide. New York: Industrial P, Incorporated, 1993.

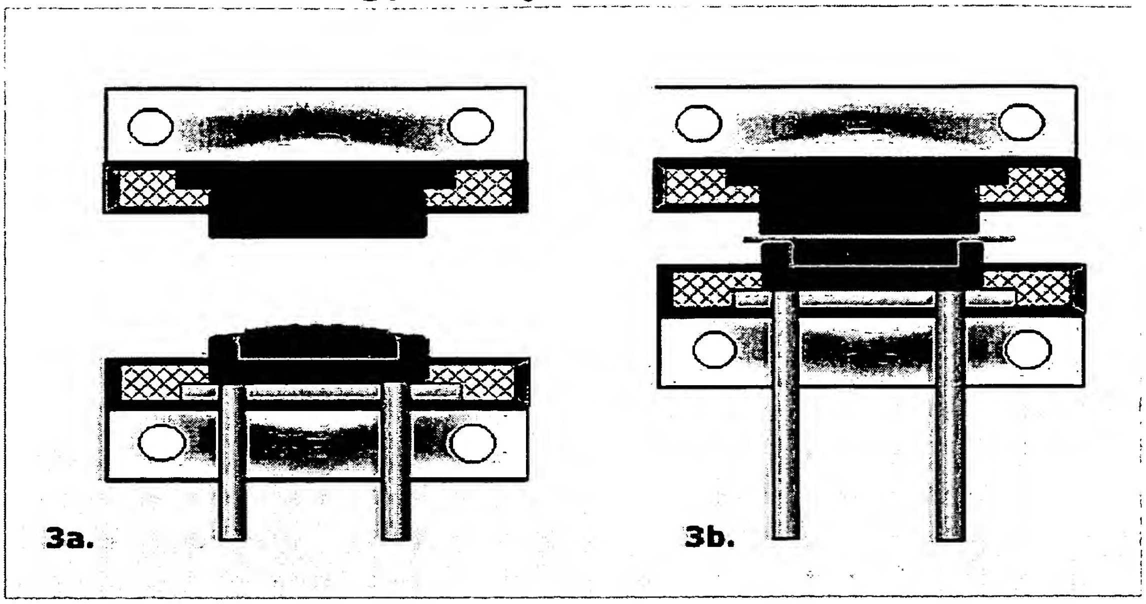
Additional information

1)http://www.ticona.com/home/tech/processing/compression_molding.htm

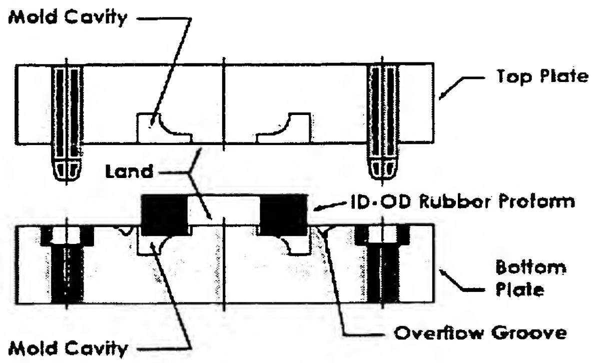
2)Manufacturing processes Reference Guide By Robert H. Todd, Dell K. Allen, and Leo Alting on page 219-220

3)Compression Molding, ASM Handbook 2001, volume 21 Composites, Peterson, Charles W, Ehnert G, Liebold R and Kühfusz R pp516-535, ISBN 0-817170-703-9

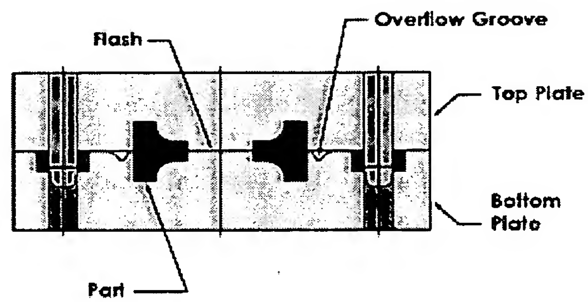
COMPRESSION MOLDING



Compression Molding



Compression Mold - Open



Compression Mold - Closed